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IoT Based Flood Monitoring and Alerting System

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Abstract: ***In the era of rapid technical advancements, the convergence of Internet of Things (IOT) technology and environmental monitoring has paved the way for groundbreaking solutions that address critical challenges faced by communities worldwide. Among these challenges, the increasing frequency and severity of flooding events have spurred the development of advanced flood monitoring and alerting systems. One such cutting-edge solution is the IOT based Flood Monitoring and Alerting System, a trans-formative approach that harnesses the power of interconnected devices and real-time data analysis to mitigate the impact of flooding and enhance disaster preparedness. Floods pose a significant threat to lives, property, and the environment. Timely detection and rapid response are essential to mitigate the impact of floods.***

In this context, we present an IOT based Flood Monitoring and Alerting System designed to provide early warning, real-time monitoring, and data-driven insights for effective flood management. Our system leverages Internet of Things (IOT) technologies to collect data from various sensors distributed across flood-prone areas. These sensors continuously monitor environmental conditions and transmit data securely to a central server or Thing speak cloud platform. Through advanced data analytic and predictive modeling, our system forecasts potential flood events, assesses their severity, and triggers automated alerts when predefined thresholds are exceeded. The alerts generated by our system are delivered through multiple communication channels, such as SMS, mobile apps, ensuring that residents, emergency services, and local authorities receive timely and accurate information. This enables proactive decision-making and coordinated responses, including evacuation and asset protection measures.

Keywords: ***Floods, IOT, Thing speak, Water levels, SMS, Alerts***

I. INTRODUCTION

One of the most destructive natural disasters is flooding, especially in areas like India where monsoonal rains can cause abrupt and sharp rises in water levels. Floods can have severe impacts, especially on people in low- to middle-income countries who don't have the infrastructure to properly protect and respond, or are already vulnerable. Understanding the incidence, severity, and aftereffects of natural disasters is essential if the goal is to improve preparedness and protect people's lives and means of subsistence.We describe a prototype flood monitoring system based on the Internet of Things (IoT) with the goal of early identification and avoidance in response to this persistent menace. The system collects real-time environmental data via a network of sensors set up in flood-prone areas, with an emphasis on variables including soil moisture, rainfall intensity, and water level.The Raspberry Pi gateway, which is attached to these sensors, gathers and processes the data before sending it to the cloud-based Thing Speak platform for additional examination. Users of Thing Speak can access the gathered data using a smart phone application, giving them insight into the conditions in the area in which they stand right now.

The system's capacity to immediately send out warnings when water levels cross crucial thresholds is one of its main advantages. This is made possible by highly developed algorithms that monitor incoming data continuously for patterns that point to impending flooding. The device automatically sends out SMS alerts to authorities and communities when it detects such conditions, giving them time to take preventative action to lessen the effects of the approaching flood.The technique makes sure that alerts are received by a large number of people, even those who live in distant or under served areas and lack access to traditional communication infrastructure, by taking use of the widespread use of mobile phones. This is especially important in areas like India, where dense populations are frequently located near riverbanks that are vulnerable to flooding.

Our Internet of Things (IoT)-based flood monitoring system exemplifies a proactive approach to disaster management by utilizing technology to enable communities to take preventative measures and deliver early warnings. The system's objectives are to minimize the socioeconomic impact of floods in susceptible places like India and reduce casualties by targeted notifications, real-time data processing, and ongoing monitoring.

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II. LITERATURE REVIEW

Kiran Jadhav, Aniket Patil, Ajay Yamkar, Mrunmai Nagtodege [1] proposed a system that indicates the water level and movement in riverbeds using an Arduino Uno, sensors, and a Wi-Fi module, in case of the level reaching the threshold, system generates early email alerts making everyone aware of the flood possibilities.

Harshali S. Mali, Ashwini R. Marathe, Priyanka K. Patil, Mr. Harshad Patil[2] suggested a system that uses the Arduino Mega 2560 as the primary microcontroller and the Blynk Application for notification, specifically for parking places, to inform and warn the vehicle owner.

Bhushan Moundekar1, Nitish Halde1, Priyanka Waghulkar1, Sunakshi Ganvir, Prof. S.D. Kakde [3] proposed a system that uses an ultrasonic sensor and an ATMEGA328P microcontroller to automatically detect the water level in reservoirs and cannels. It then uses the Wi-Fi module to relay these values to the control room and the GSM module to send an SMS alarm.

K. R. Jaware, D. S. Chavan, and P. M. Mane[4] proposes a system that gathers information on flood-related characteristics using a range of sensors, such as humidity, rainfall, and water level sensors. An Arduino microcontroller is used by the system to process sensor data and provide email and SMS flood notifications to authorities and residents.

A. Kumar and S. Kaur [5] provides a comprehensive overview of IoT-based flood prediction and alerting systems. The paper also discusses the use of machine learning techniques to improve the accuracy of flood predictions.

k Subramanya Chari, Maturi Thirupathi2, Hariveena. Ch [6] proposed a system that uses rain and water sensor along with Raspberry Pi as main controller when surpasses the threshold limit value, the algorithm calculates how long it would take for flooding to occur in the area and notify the villagers.

Wahidah MdShah,Fahmi Arif, A.A.Shahrin, Aslinda Hassan[7] proposed a system that can measure the water level's rising rate and notify the resident in addition to simply detecting the water level.The waterfall model is used as the methodology. Data from the water sensor is gathered by Raspberry Pi and sent to a GSM module so that an SMS alarm can be sent.

Anisha Daniel P J , Abhishek M L, Frelbin Nazeer, Ann Johny[8] proposed a system in which Arduino Mega and water/rain sensors are used in the development of a flood monitoring and alerting system. Because this method gives authorities real-time data on changes in river stages, they can quickly analyze concerns. It forecasts the impacted areas and sends out immediate IoT alerts on detection of flood.

Garima Singh, Nishita Bisht, Pravesh Bisht, Prajjwal Singh [9] proposed the development strategies for a flood alerting and monitoring system based on the Internet of Things that uses open weather API for weather forecasting.

III. METHODOLOGY

Nowadays, there is no idea about when flood will occur, so there is need to prepare such system for people who are near the flood prone area. Therefore, the purpose of this system's design is to send out alert signals to individuals about the approaching flood.. The basic working of project consists monitoring of water levels and values of other sensors used against predefined threshold values and if collected sensor values exceed threshold values potential flood is detected and alerts are sent through SMS.After thorough literature survey we decided to use

1) Raspberry Pi board as main controller instead of Arduino board because in Arduino board we will have to connect GSM module externally to create SMS alerts via internet based SMS gate service whereas in Raspberry Pi we can create SMS alerts via internet based SMS gate service without need to connect GSM module externally.
2) DHT11 (Temperature and Humidity Sensor) to detect real-time temperature and humidity of environment.
3) HC-SR04 (Ultrasonic Sensor) to check rise or fall in water level.Once the water level increases beyond threshold, a trigger is generated that causes an SMS Alert warning about the potential for flood.
4) Water Flow Sensor to check real-time water flow.
5) Buzzer to give alert when it gets triggered.

For software setup we have used Raspbian which is Operating system of Raspberry Pi and Python IDLE for writing Python program. The Raspberry Pi is used by the application to read the sensor inputs. We set a threshold value in the ultrasonic sensor program for the water level in three levels: normal water level causes the green LED to turn on; at medium water level, the yellow LED glows on; and once the water level reaches the highest threshold level, the red LED and buzzer turn on. In other words, if the water level is at the closest distance from the ultrasonic sensor, a trigger instructs the program to send out an SMS alert warning people about the potential for flooding and rising water levels. We have also written program for rain sensor and water flow sensor for getting SMS alert regarding Rain and high water flow respectively.

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Furthermore, we also created channel on Thing Speak Platform for displaying real-time sensor values in graphical form which makes it easier to study sensor values time to time.

IV. RESULTS

Fig.1 shows a Hardware Setup using a Raspberry Pi 3B+, we were able to create a flood monitoring and alerting system, DHT11 (Temperature and Humidity Sensor), HC-SR04 (Ultrasonic Sensor), Water Flow Sensor and buzzer. Along with real-time readings on the Thing Speak Platform, we have also added SMS alerts.

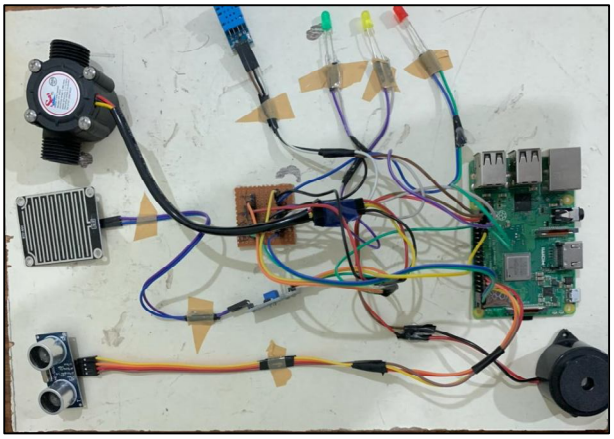

Fig. 1 Hardware Setup

Fig.2 shows snapshot of SMS alert that is received when rainfall is detected by rain sensor.

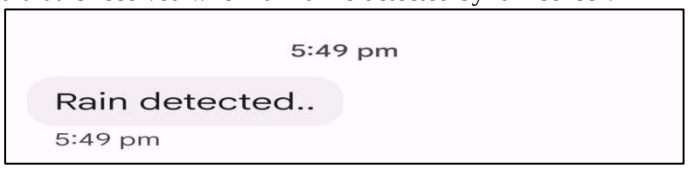

Fig. 2: Rain sensor SMS alert

Fig.3 shows snapshot of SMS alert that is received when water level more than predefined threshold value is detected by ultrasonic sensor.

Fig. 3: ultrasonic sensor SMS alert

Fig.4 shows snapshot of SMS alert that is received when water flow detected by water flow sensor exceeds predefined threshold

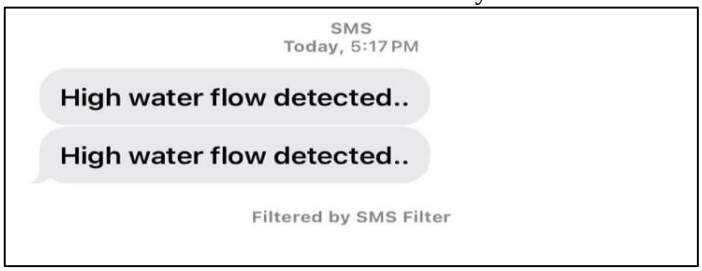

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Fig.4: Water flow sensor SMS alert

Fig.5 shows snapshot of Real-time sensor values that can be seen on Thing Speak platform in graphical form.

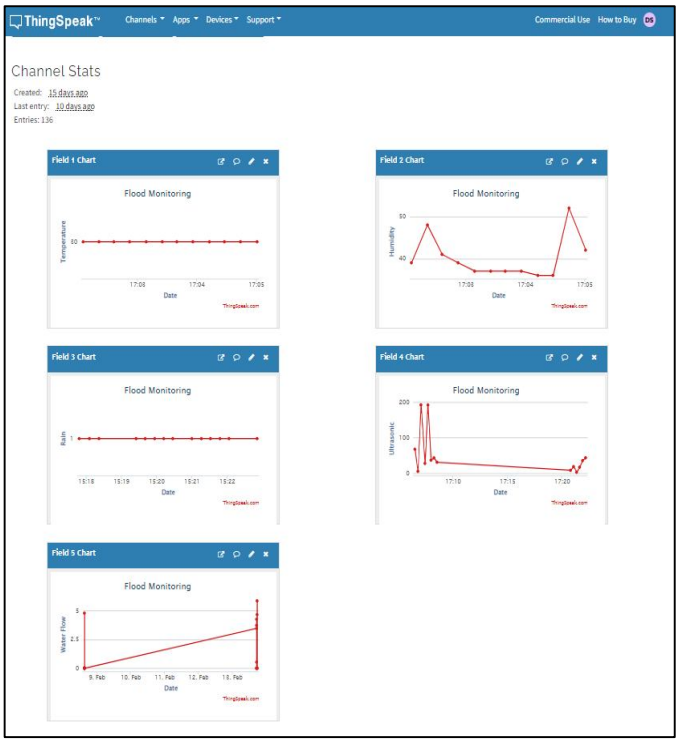

Fig.5: Sensor Data on Thing Speak

V. FUTURE SCOPE

The integration of flood monitoring and alerting systems with other disaster management systems is becoming more and more important. This covers systems including transportation management systems, emergency response systems, and early warning systems. We can increase the efficacy and coordination of our flood response by integrating these systems.

Artificial intelligence (AI)-driven flood forecasting systems**:**Artificial intelligence (AI)-driven flood forecasting systems are able to anticipate flood inundation areas and water depths in real time. Plans for evacuation and early warning systems can be updated with this knowledge.

Intelligent flood warning systems: Alerts can be tailored to each community's specific needs by use of intelligent flood warning systems.A warning system for a heavily populated urban area might differ from one for a rural community, for instance.

Infrastructure that is resistant to flooding: Bridges, roads, and buildings that are resistant to flooding can be developed with the help of flood monitoring and alerting systems. Sensors, for instance, can be used to track the health of infrastructure and spot possible flaws.

For example, a warning system for a rural community might be different from a warning system for a densely populated urban area.

Flood insurance: Flood monitoring and alerting systems can be used by insurance companies to assess the risk of flooding in different areas and set premiums accordingly.

VI. CONCLUSIONS

IOT - based flood monitoring and alerting systems have the potential to improve our ability to detect and respond to floods. By using a network of interconnected sensors and devices, these systems can provide real-time information on water levels, rainfall, and other environmental factors like temperature, humidity etc. This data can then be used to generate accurate flood forecasts and warnings, which can be disseminated to nearby inhabitants and authorities in real time.

Overall, IOT - based flood monitoring and alerting systems have the potential to play a highly significant role in reducing the loss of life and property damage brought on by floods. By providing early warning and supporting other aspects of flood management, these systems can help communities to better prepare for and respond to floods.

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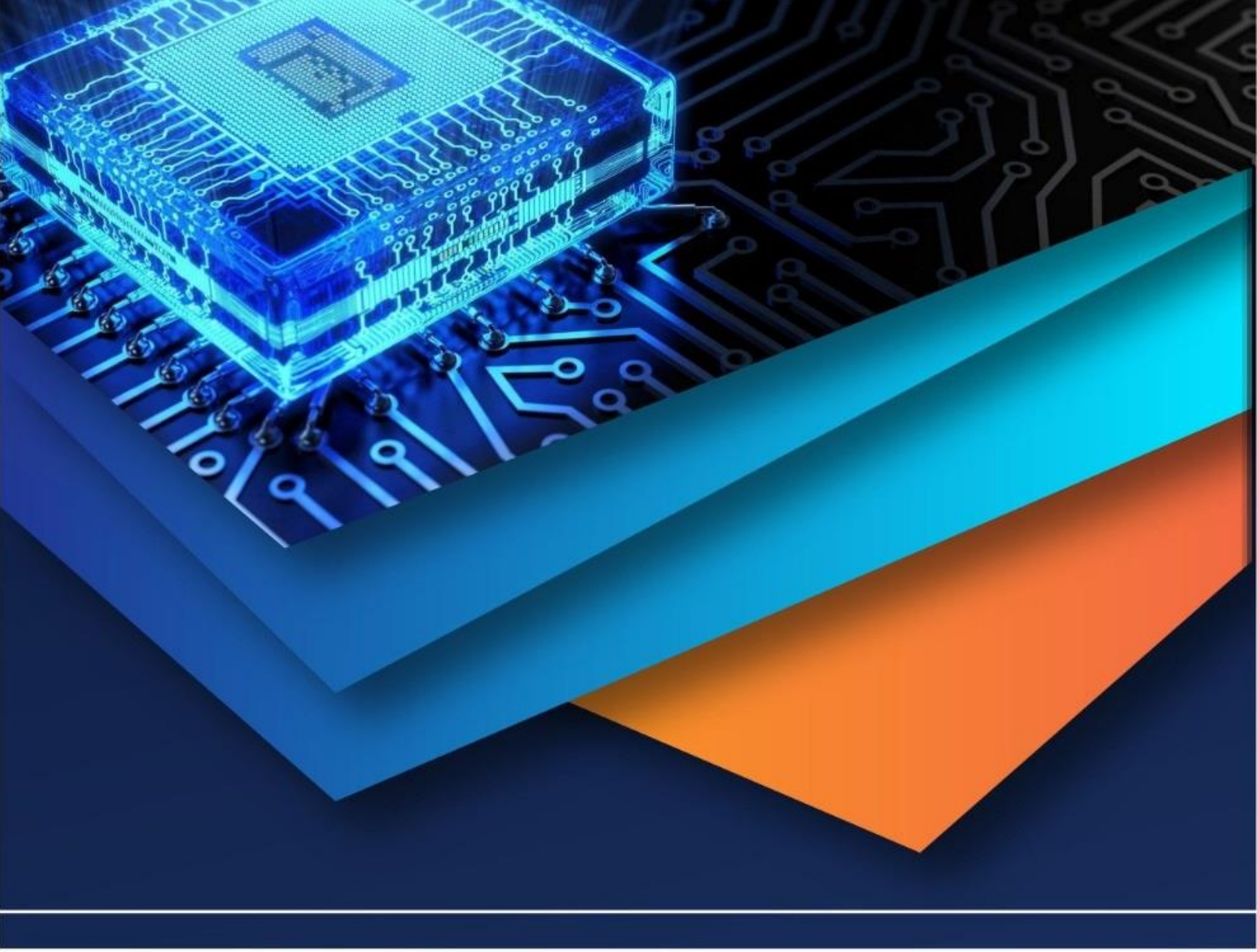

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